OLLSCOIL NA GAILLIMHE
UNIVERSITY OF GALWAY

Autumn Examinations 2023-2024

Course Instance Code(s)	4BCT1, 4BS2
Exam(s)	Fourth B.Sc. Computer Science and IT Fourth Science
Module Code(s)	CT421
Module(s)	Artificial Intelligence
Paper No.	1
External Examiner(s)	Dr. R. Trestian
Internal Examiner(s)	Professor M. Madden *Dr. C. O'Riordan

Instructions: Answer any 3 questions. All questions are equally weighted.

Duration	2 hours
No. of Pages	3
Discipline(s)	Computer Science
Course Co-ordinator(s)	Dr. C. O'Riordan

Requirements:

Release in Exam Venue	No [ ]	Yes [☑]
MCQ Answer sheet	No [☑]	Yes [ ]
Handout	No [☑]	Yes [ ]
Formulae & Tables*	No [☑]	Yes [ ]
Cambridge Tables 2nd Edition**	No [☑]	Yes [ ]
Graph Paper*** A4 Graph Paper 1mm 0.1cm Squared (Standard)	No [☑]	Yes [ ]
Other Materials	No [☑]	Yes [ ]
Graphic material in colour	No [☑]	Yes [ ]

End of requirements.

PTO

Q.1.

(a) For the following three approaches, explain with an example how they differ in the order that nodes are visited in a tree:

Breadth first search
Depth first search
Iterative Deepening

Compare the three techniques under the following headings:

Time complexity
Space complexity
Completeness

(9)

(b) In adversarial search the minimax algorithm and alpha-beta pruning are often employed. Using a suitable example, explain in your words these two approaches. (8)

(c) Explain the motivations underlying the novelty search approach and explain, with an example domain of your choice, how the approach could be implemented. (8)

Q.2.

(a) Explain the schema theorem in the context of genetic algorithms. What are the key principles of the schema theorem? Discuss the roles of crossover, mutation and selection with reference to the schema theorem. (11)

(b) The multiple knapsack problem can be stated as follows: There exist N items each with a corresponding value and weight. The goal is to place a subset of these items into a set of knapsacks such that the value of the items placed in the knapsack is maximised. Each knapsack as a capacity (maximum weight). You cannot place items into a knapsack greater than the capacity of the knapsack. Each instantiation of the problem is a list of items (with value and weight) and a list of knapsacks with their maximum capacity.

i) Describe a suitable fitness function
ii) ii) Describe a suitable representation of the chromosomes in your population
iii) Discuss how you might implement mutation
iv) Discuss how you might implement crossover.

(14)

PTO

Q.3.

(a) Explain what is meant by speech acts within multi-agent systems. Considering a negotiation setting, provide examples of different types of speech acts that agents could use. (7)

(b) Game theory has been used in a number of domains to model and reason about strategic decision making. Explain, with examples, the following concepts: a dominant strategy, Nash equilibrium. (8)

(c) Artificial Life attempts to explore study aspects of living systems. Choosing any suitable examples:

i) Discuss an example that shows the emergence of complex behaviours given simple rules of interaction.

ii) Discuss an example where properties of a naturally occurring system has been used to inform the design of useful algorithms (10)

Q.4.

(a) Neural networks have been shown to be effective in supervised learning. Explain, in your own words how this learning occurs. Your answer should explain the structure of the network, how a result is generated and how it 'learns' from previous examples. (8)

(b) Explain briefly the importance of *explainability* in artificial intelligence. With respect to deep learning, outline approaches that can be used to provide explanations. (8)

(c) Explain the term *ant-colony optimisation* and show with a simple example how ant colony optimisation could be used to find solutions to the travelling salesperson problem. (9)

END